

Experimental Work on a New Standard of Light.

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The competition between flame and incandescent standards of light, which has existed almost since the necessity for a standard began to be realised, has resolved itself for the time being into a compromise, so that, while Europe continues to employ the flame standard and America the electric glow-lamp, the relation of these two has been accurately determined, and they are now expressible in terms of the accepted International standard candle.* This state of affairs, however, can hardly be considered as final, and effort has not altogether ceased to be directed towards finding some standard free from the defects of those at present in use. The following is an account of the results of an examination of an incandescent standard proposed some years ago.†

In bringing forward the original proposal, a review of the state of the subject led to the following conclusions:—

(1) The Violle molten platinum standard is satisfactory as an absolute standard of reference.

(2) The flame standards are the most convenient for general use, and are of sufficient accuracy for commercial purposes.

(3) The secondary standard, intended to serve as a go-between from the absolute to the commercial standards, are in the least satisfactory state of the three. The sets of Fleming large-bulb glow-lamps, which are now so largely used, are subject to a gradual decay and to the multiplication of photometric errors by successive inter-comparison.

The suggested new standard was intended to fill the gap, by providing a single apparatus, which should be free from the above defects. The principle upon which it was based consisted in taking the quality of the radiation itself as the criterion by which the temperature of the radiator was regulated.

The sensitiveness and accuracy of the spectrophotometer and spectrophotometer proved to be insufficient for this purpose, and the analysis of the radiation was obtained by making use of the selective absorption of black fluorspar and water, the former of which transmits essentially radiation of long wave-length, to which the latter is nearly opaque.

The method used may be described as follows: The electric radiator consists of a wide strip of metal placed behind a water-cooled diaphragm. Two thermopiles, connected in opposition, are placed on the right and left of

* 'Phil. Mag.,' August, 1909, vol. 18, p. 263.

† 'Electrician,' April 10, 1903, vol. 50, p. 1012.

the axis of the photometer, and receive respectively the radiation passing through a plate of black fluorspar and through a water-trough. As the temperature of the radiating strip increases, the percentage of the total radiation which penetrates the water will increase, and the percentage which penetrates the fluorspar will decrease. At some temperature the two will be equal, and the electromotive force in the galvanometer circuit will therefore fall to zero. This zero point may be used to fix the standard temperature.

The choice of a suitable material for the radiator offered some difficulty. The emissivity of the oxides of the rare earths alters under prolonged heating, and only the metals of the platinum group will withstand exposure to air when at a high temperature. Iridium disintegrates rapidly at temperatures above 1600° C., a continuous stream of black smoke arising from the surface of the metal. The loss of weight measured on various occasions amounted to about 4 mgrm. per square centimetre per hour. The evaporation of platinum is about 10 times slower, but, unless the metal is chemically pure, a gradual change in the texture of the surface produces a variation in the intensity of the light emitted.

After a long series of experiments, chemically pure platinum was chosen as the radiating substance. The apparatus was first set up, and subjected to tests extending over several months. The experience thus gained resulted in the construction of a self-contained instrument, the cost of which was defrayed by the Government Grant Committee of the Royal Society.

The platinum strip, 7×1.2 cm. and about 0.05 mm. thick, was stretched between two water-cooled clips connected to a low-tension battery through a variable resistance. The strip was enclosed in a cylindrical water-cooled casing having three apertures. The light, passing through a diaphragm, was directed on the photometer head, and the radiation emitted from the other side of the same portion of the strip reached the two thermopiles, which were placed at 30° to the axis of the photometer.

Careful tests proved that, with suitable precautions, the variations in intensity of the light emitted by such an apparatus will not exceed ± 0.5 per cent., and in this respect the result of the work can be considered entirely successful. On the other hand, this form of standard is not portable, the intensity of the light emitted is low, its colour unsatisfactory, and, finally, much skill and care is required in the adjustment of the very sensitive thermo-electric circuit. From a practical point of view, these defects are probably sufficient to outweigh the advantage gained with regard to accuracy, and it is therefore thought unnecessary to give a detailed account of the experimental work.
